

REMARKS

The applicants thank the Examiner for the thorough examination of the application. The specification has been amended to correct minor errors. No new matter is believed to be added to the application by this amendment.

Status of the Claims

Claims 1-25 are pending in the application. Claims 9-11 and 17 find support at page 4, lines 9-14 of the specification. Claims 12-14 and 18 find support at page 3, lines 11-15 of the specification. Claim 15 finds support at page 7, lines 1-4 and at page 3, line 17 of the specification. Claim 16 finds support at page 3, lines 19-21 of the specification. Claims 19-22 find support at page 5, lines 5-20 of the specification. Claims 23 and 24 find support at page 2, lines 7-9, at page 2, line 21 to page 3, line 8, and at page 9, lines 13-14 of the specification. Claim 25 finds support at page 4, lines 21-24 of the specification.

Rejection Under 35 U.S.C. §112, Second Paragraph (Paragraphs 1-2 of the Office Action)

Claim 4 is rejected under 35 U.S.C. §112, second paragraph as being indefinite. Applicants traverse.

The Examiner asserts that claim 4 contains the trademark "Nafion" which has a changeable meaning. However, the Preliminary Amendment filed March 7, 2001 removed the trademark "Nafion" from claim 4, thus mooting this rejection.

This rejection is accordingly overcome and withdrawal thereof is respectfully requested.

Rejection Under 35 U.S.C. §102(b) Over Heller (Paragraphs 3-4 of the Office Action)

Claims 1-3 and 5-8 are rejected under 35 U.S.C. §102(b) as being anticipated by Heller (U.S. Patent 5,854,169). Applicants traverse.

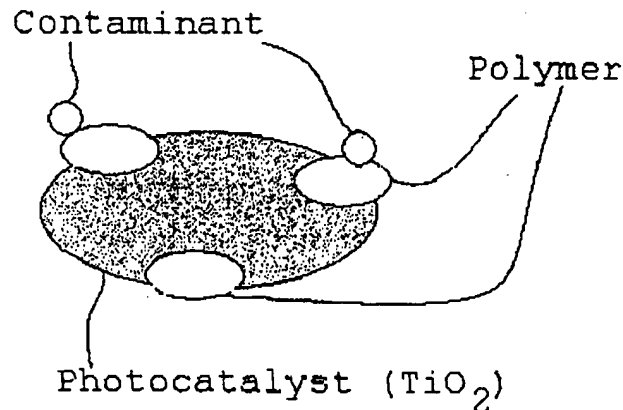
The Present Invention and its Advantages

The present invention as is typically embodied in claim 1 recites: “A high-function photocatalyst having its surface partially covered with a polymer having an anionic group.”

One of the important features of the present invention resides in that a photocatalyst has its surface **partially** covered by a polymer having an anionic group. In the invention, the anionic group can attract and hold a negative contaminant. Because the photocatalyst's surface is partially covered, when the anionic group traps a contaminant, this contaminant is brought into close proximity with the photocatalyst. The photocatalyst thereby easily and effectively decomposes the contaminant.

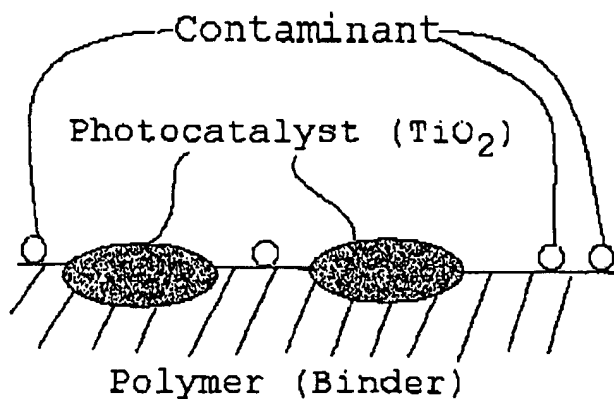
Further, because the polymer has an anionic group, the charge (electron) of the contaminant may transfer to the photocatalyst, whereby a radical may be produced. This radical further accelerates decomposition of the contaminant.

An illustration of an embodiment of the invention is reproduced below.



The above illustration shows that the amount of TiO_2 is significantly large when compared to the polymer. Therefore, when a contaminant adheres to the polymer, TiO_2 in the vicinity of the polymer effectively decomposes the polymer.

In contrast, the conventional art technology is illustrated below.



Here, the contaminant is far from TiO_2 and is hardly decomposed.

The conventional art illustrated above utilizes an amount of polymer (binder) that is very high when compared to that of TiO_2 . If a contaminant particle becomes trapped by the polymer, the decomposition effect is unsatisfactory.

Also, the photocatalyst of the conventional art is buried in the polymer so that only a part of the photocatalyst is exposed. As a result, there is only a limited amount of the surface area of the photocatalyst available to react with the contaminants. Accordingly, the small effective area of the photocatalyst results in unsatisfactory decomposition of pollutants.

As follows from the above graphical explanations, the present invention has an optimal concentration of polymer that is lower than that of the conventional art, because the inventive photocatalyst is only partially covered by polymer. The present invention accordingly uses an amount of polymer that is preferably as small as 0.05 to 5 ml in 5% by weight solution per g of photocatalyst (see claim 25).

The small amount of polymer leaves most of the surface of the photocatalyst exposed to the environment, and a contaminant trapped by the polymer readily comes into contact with the catalyst.

That is, the present invention by, for example, using the polymer in an amount of 0.05 to 5 ml in 5% by weight solution per g of photocatalyst, cannot cover the entire surface of the photocatalyst, but can only cover a part of the surface. Further, since the photocatalyst is only partially covered, the photocatalyst cannot be buried in the polymer at all.

In contrast, the conventional art uses excess polymer so that most of the photocatalyst is buried or occluded, and little of the photocatalyst is exposed. As a result, there is little charge transfer between the polymer and the photocatalyst. The invention therefore has fundamental differences over the conventional art cited by the Examiner.

Distinctions of the Invention over Heller

Heller pertains to a photocatalyst-binder combination. Heller at column 4, line 60 refers to a “photocatalyst dispersed within a binder.” Figures 1 and 2 of Heller show a photocatalyst bed packed with glass spheres 2 “coated on all exposed surfaces, except at contact points 4 with other spheres or with the conduit 8, with the photocatalyst-binder composition of the present invention.”

See Heller at column 12, lines 57-60.

Heller fails to disclose an anionic polymer partially covering a catalyst.

The Examiner asserts that Heller at column 6, lines 40-49 and 58-67 discloses using polymers having anionic groups. However, the silane polymers listed by Heller are non-ionic. Further, the amount of binder utilized by Heller is 27 to 28% (see Table 1 at column 14 of Heller), and this amount of binder is too large to result in the partial coverage of the invention (see claim 25).

In contrast, the invention pertains not to a binder, but to partially coating a catalyst particle with an anionic polymer that will attract pollutants to the catalyst particle. For example, page 4, line 3 of the specification discusses a separate step

of immobilizing the photocatalyst with a binder. Also, see claims 7 and 8. Further, the paragraph at page 5, lines 5-20 of the specification discusses the functionality of the inventive polymer coating, and this functionality is clearly fundamentally different from the binder of Heller. See claims 19-22. Thus, the anionic polymer of the invention is clearly not equivalent to the binder of Heller.

Further, Heller teaches: "The preferred binders do contain oxidizable carbon and or hydrogen atoms, not in the backbone, but covalently bound to the backbone atoms." Heller at column 5, lines 31-33. Heller at column 6, lines 40-63 lists the Si backbone polymers of their binder. In contrast, the anionic polymers of the invention can have carbon in the backbone. See claims 4 and claims 9-11.

Heller thus clearly fails to anticipate the claimed invention. This rejection is accordingly overcome and withdrawal thereof is respectfully requested.

Rejections Based Upon Murasawa (Paragraphs 5-7 of the Office Action)

Claims 1, 2 and 6-8 are rejected under 35 U.S.C. §102(b) as being anticipated by Murasawa (U.S. Patent 5,547,823). Claim 4 is rejected under 35 U.S.C. §103(a) as being obvious over Murasawa in view of Eckberg (U.S. Patent 5,583,195). Applicants traverse.

The objects and advantages of the present invention have been discussed above. An important features of the present invention resides in that a

photocatalyst has its surface ***partially*** covered by a polymer having an anionic group.

Murasawa pertains to a photocatalyst composite that includes a substrate having particles of titanium dioxide adhered thereon using an adhesive such as a fluorinated polymer or a silicon-based polymer. Murasawa fails to disclose an anionic polymer. Murasawa further fails to disclose a partially covered photocatalyst.

The Examiner asserts that Example 1 of Murasawa discloses a photocatalyst mixed with a polymer having an anionic group. However, Example 1 of Murasawa uses “a fluorinated polymer comprising primarily a copolymer of vinyl and fluoroolefin.” See Murasawa at column 6, lines 52-54. Murasawa thus fails to disclose a catalyst partially coated with a polymer containing an anionic group for attracting pollutant particles to the photocatalyst. See instant claims 19-22 of the invention.

At page 4, lines 24-25 of the Office Action, the Examiner asserts that “Murasawa discloses mixing specifically with ‘fluorinated polymers’ (see column 38-50).” However, Murasawa has 14 columns and columns 38-50 could not be found. On the other hand, Murasawa’s column 3, lines 38-50 lists fluorinated polymers for the “less degradative adhesive” as follows:

The fluorinated polymers to be used include, for example, crystalline fluorinated resins such as polyvinyl fluorides, polyvinylidene fluorides, polyethylene trifluorochlorides, polyethylene tetrafluorides, tetrafluoroethylene-hexafluoropropylene copolymers, ethylene-polyethylene tetrafluoride copolymers, ethylene-ethylene

trifluorochloride copolymers, tetrafluoroethylene-perfluoroalkylvinyl ether copolymers, amorphous fluorinated resins such as perfluorocyclo polymers, vinyl ether-fluoroolefin copolymers, vinyl ester-fluoroolefin copolymers, various fluorinated elastomers and the like. Particularly fluorinated polymers comprising primarily vinyl ether-fluoroolefin copolymers and vinyl ester-fluoroolefin copolymers are preferred because they are susceptible to less decomposition and degradation and easy to handle.

However, none of these fluoropolymers of Murasawa are anionic polymers capable of electron transfer.

Murasawa and Heller are both similar in that the polymers they use are binders or cements having low reactivity of UV light ("less degradative adhesive," Murasawa at column 3, line 9). In contrast, the polymer used in the invention is an active molecule.

The Examiner turns to Eckberg for teaching pertaining to poly(fluorine-substituted sulfonic acid). However, Eckberg fails to address the deficiencies of Murasawa in teaching or suggesting a catalyst partially covered with an anionic polymer. A person having ordinary skill would therefore would not be motivated by Murasawa or the combination of Murasawa and Eckberg to produce the invention embodied in independent claims 1 and 8. A *prima facie* case of obviousness has thus not been made. Claims dependent upon claims 1 and 8 are patentable for at least the above reasons.

These rejections are accordingly overcome and withdrawal thereof is respectfully requested.

Prior Art

The prior art cited but not utilized by the Examiner indicates a status of the conventional art that the invention supercedes. Additional remarks are accordingly not necessary.

Information Disclosure Statement

Applicants thank the Examiner for considering the Information Disclosure Statement filed June 7, 2001 and for making the initialed PTO-1449 form of record in the application in the Office Action mailed November 19, 2003.

Foreign Priority

The Examiner has acknowledged foreign priority in the Office Action mailed November 19, 2003.

Conclusion

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Robert E. Goozner, Ph.D. (Reg. No. 42,593) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), Applicant(s) respectfully petition(s) for a one (1) month extension of time for filing a reply in connection with the present application, and the required fee of \$110.00 is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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